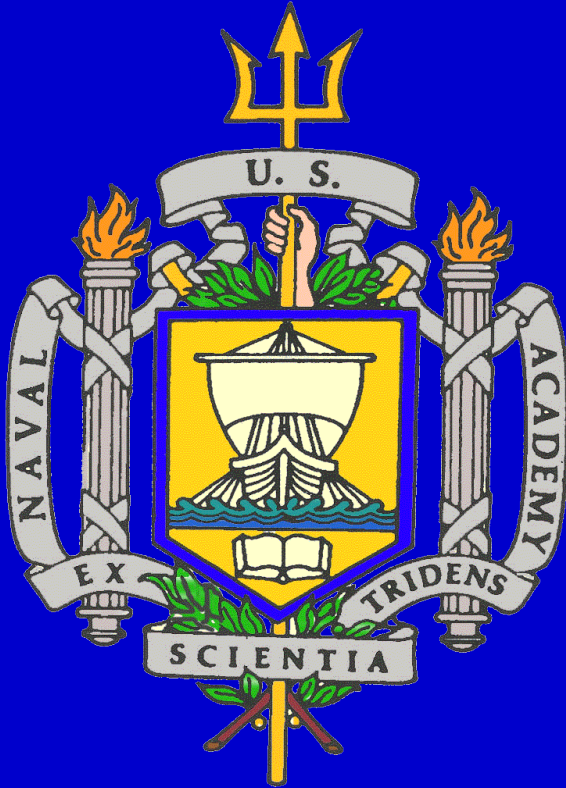


An Introduction to Naval Architecture

Associate Professor Paul H. Miller
LCDR John Stevens



Presentation Overview



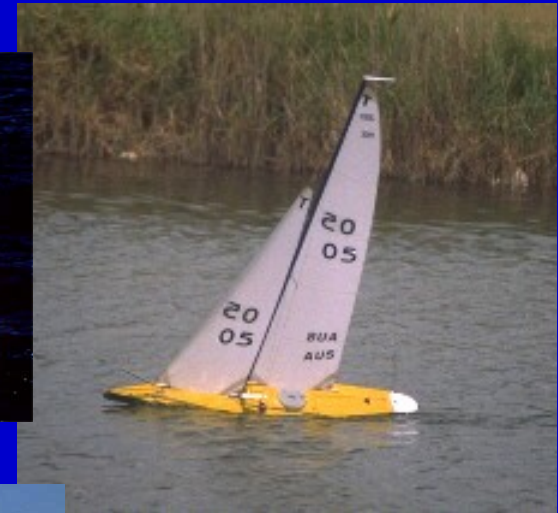
- Some sample naval arch projects
- What would you do at USNA as an ENA major?
- What will an ENA background do for you in the fleet?

Naval Architecture

- Is the design of objects that move on, or under, or just over the water
- Deals with 2/3rds of the earth's surface!
- History dating back to 5000+ BC (it is the second oldest engineering profession...)



Some of my projects!



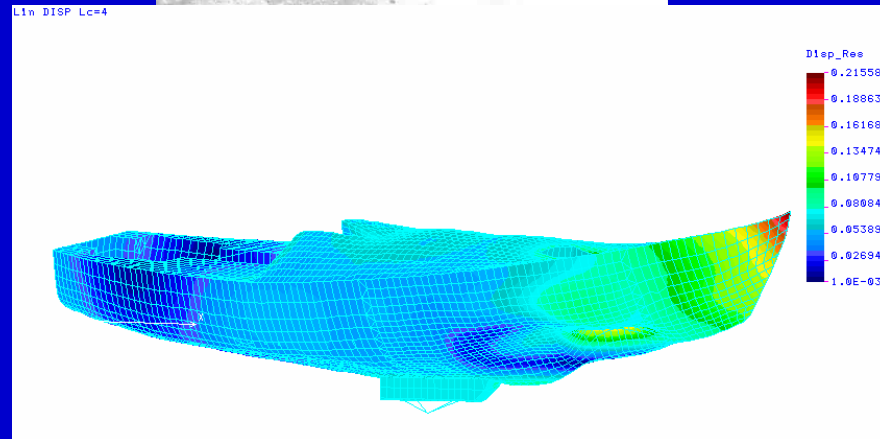
Sail...





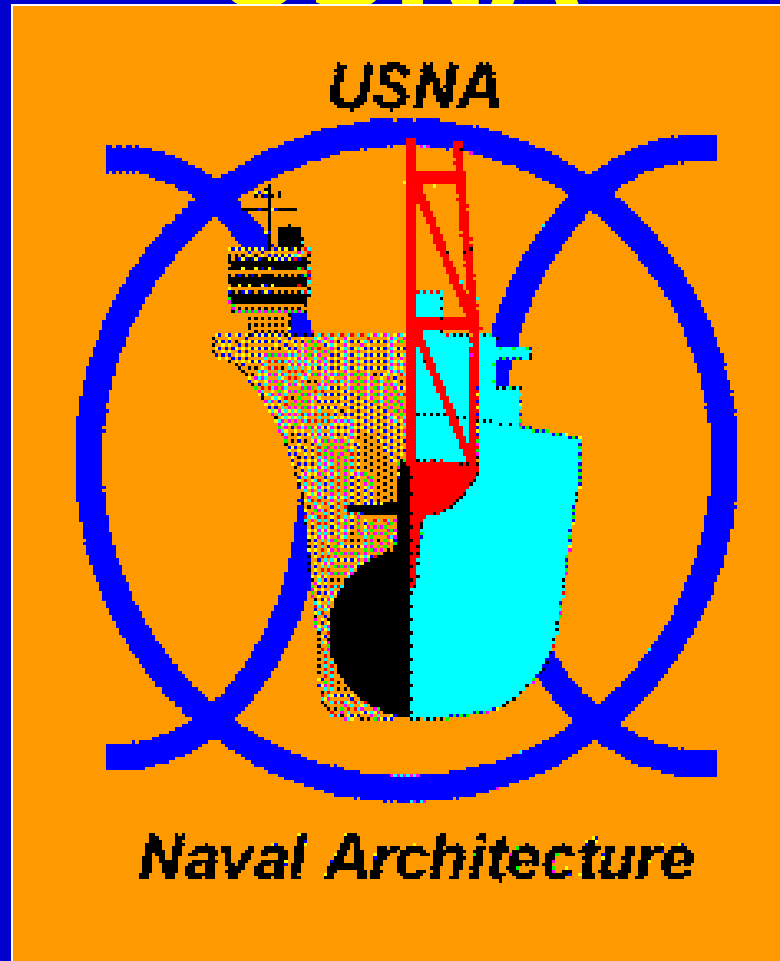
Power...





And others...!

Naval Architecture at USNA



Mission:

- **Tomorrow's Navy must operate on, below, and just above the surface of the sea using a variety of ships, submarines, and deep submergence vehicles to perform a multitude of missions focusing on defense, commerce, recreation, research, exploration, and exploitation of the world's oceans.**
- **The goal of the Naval Architecture major (ENA) is to develop engineers who are capable of effectively meeting the challenges inherent in this complex environment.**

Naval Architecture Courses:



Naval Architecture

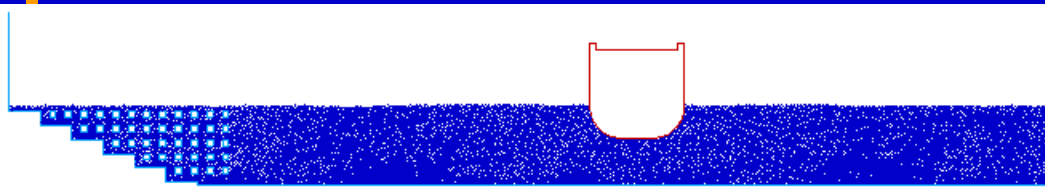
Electives:

- **EN445 - Marine Fabrication Methods (2-2-3)**
- **EN450 - Engineering Economic Analysis (3-0-3)**
- **EN452 - Structural Reliability (3-0-3)**
- **EN454 - Ship Vibrations (3-0-3)**
- **EN456 - Advanced Methods in Ship Design (3-0-3)**
- **EN457 - Hydrofoil and Propeller Design (3-0-3)**
- **EN458 - Advanced Marine Vehicles (2-2-3)**
- **EN478 - Submarine Design Analysis (3-0-3)**
- **EN481/2 - Independent Research (0-2-1)**
- **EN485/6 - Special Topics (3-0-3)**
- **EN495/6 - Independent Research (0-6-3)**

Facilities at USNA: 380 Foot Towing Tank



- Length = 380 ft
- Breadth = 26 ft
- Depth of Water = 16 ft
- Drydock Length = 34 ft
- Typical experiments: resistance and powering in both calm water and waves, intact and damaged stability, seakeeping, hydrodynamic forces on submerged bodies, flow visualization, wind loads, and a variety of unique experiments to prove concepts.



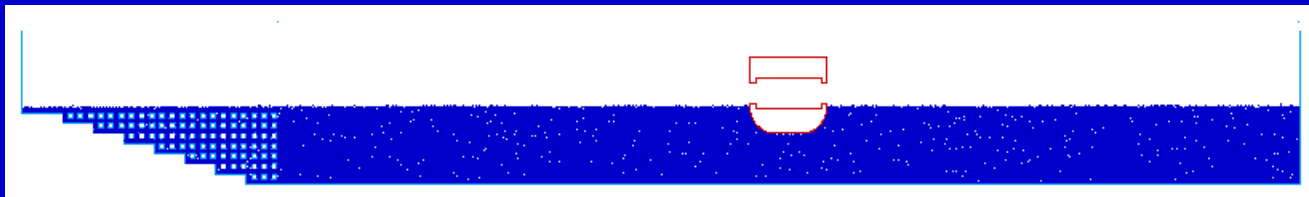
Facilities at USNA: 120 Foot Towing Tank

- Length = 120 ft
- Breadth = 8 ft
- Depth of Water = 5 ft
- The tests performed in this tank are similar to those performed in the 380 ft tank, but use smaller models. In addition, shallow water resistance tests are conducted.



Facilities at USNA: Ballast Tank

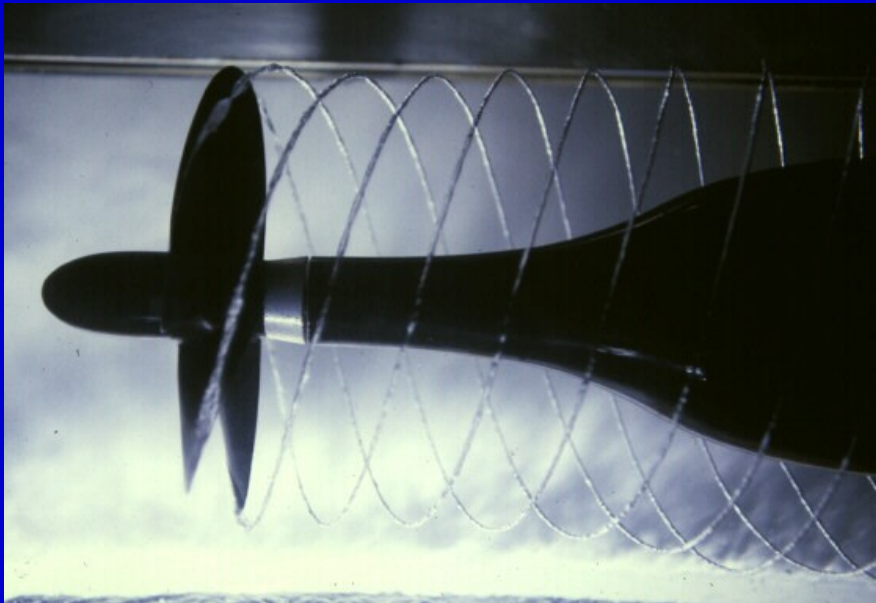
- Length = 24 ft
- Breadth = 17 ft
- Depth of Water = 3.5 ft
- This tank is used when ballasting models and to study ship stability - both intact and damaged.



Facilities at USNA:

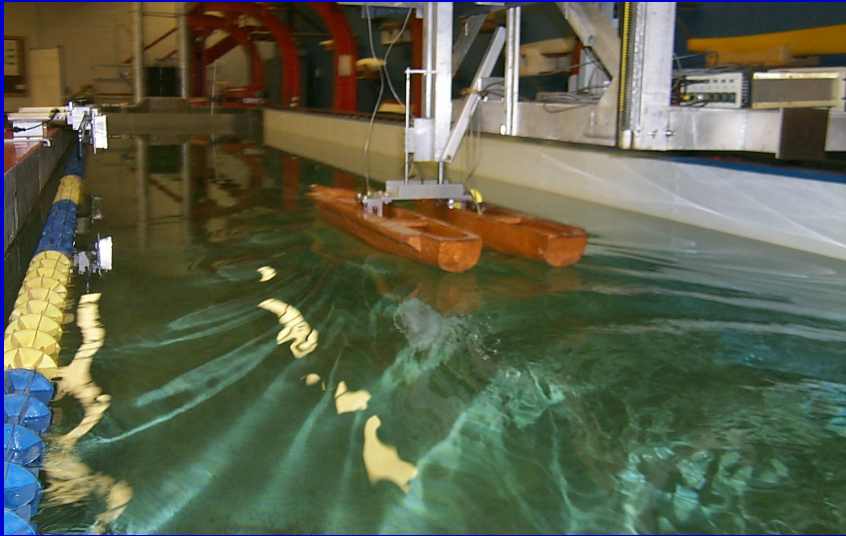
Circulating Water Channel

- **Test Section: 16" x 16" x 5 ft**



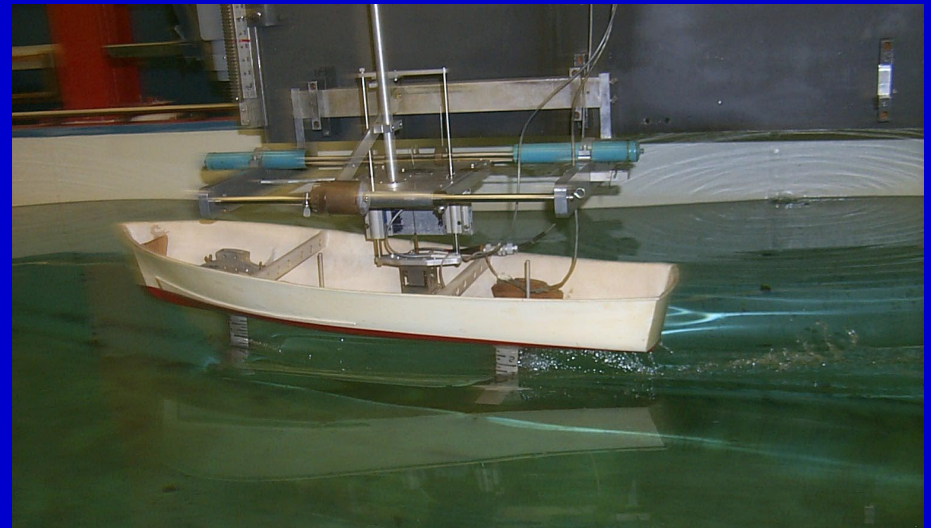
The circulating water channel is used for flow visualization, measurement of force and pressure distributions on submerged bodies, and propeller thrust and torque measurements.

Tank Testing:



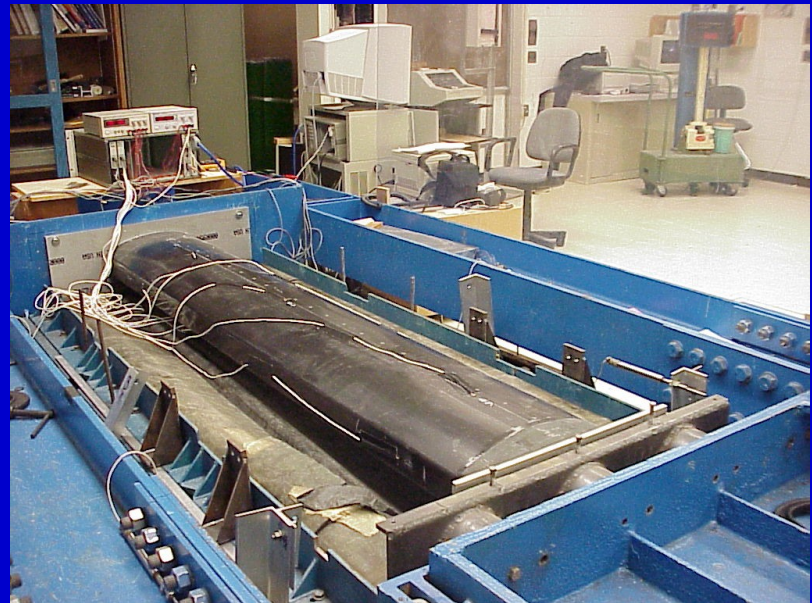
Testing a catamaran in
the 120' tank

Testing a PCH hovercraft
model in the 120' tank



Ship Structures

- The lab includes a machine capable of compression to half a million pounds! It is used for hull structure, masts, props shafts, etc.



America's Cup Yacht Mast Tests

“All Classes” ENA Field

Trips:

- **2001 – David Taylor Research Center**
- **2002 – USCGC Rankine underway exercise**
- **2003 – Newport News Shipbuilding**
- **2004 – David Taylor Research Center**
- **2005 – Little Creek Amphibious Craft**
- **2006 – Newport News (CVN77 and**



Midshipmen from
the Classes of
2003, 2004, and
2005 at Newport
News
Shipbuilding
-March 2003.

Some ENA Trident Scholars

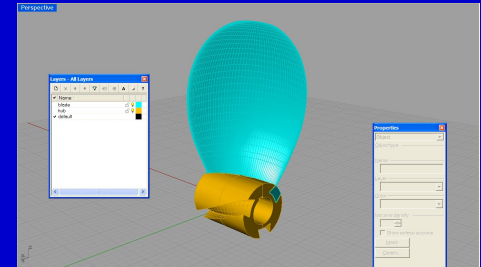
Chris Wozniak '05 - Research, Design, Fabrication and Testing of a Carbon Fiber Propeller for a YP

Jared Patton '04 - Evaluation of Dynamic Lift Coefficients on High Aspect Ratio Rudders and Control Surfaces

Jon Silverberg '03 - Methods of Ship Performance Prediction and Design with Tank Testing and CFD

Tullio Celano III '98 - The Control of Running Trim and Its Effects on the Calm Water Performance of Modern Planing Craft

Casey Moton '91 - Open-water Resistance and Seakeeping Characteristics of Ships with Ice-breaking Bows



Some ENA Independent Research Projects

***HMS Inconstant:* Preparation for Model Testing**

Re-Invention of the Propeller for Bushnell's Turtle

Model Testing of Seakeeping Characteristics of the 47' USCG Motor Life Boat

Performance Evaluation of Sailboat Rudders

Analytical and Experimental Evaluation of ABS Wood Construction Criteria

**Calm Water Testing of the HYSWAS Concept
"Streetfighter"**

A Model Test Comparison Between a Trimaran and a Monohull in Regular and Irregular Waves

Some Recent ENA Capstone Design Projects

- **Chesapeake Bay oceanographic research vessel**
- **Coast Guard patrol boat**
- **Navy 44 replacement design**
- **Cleveland fireboat**
- **San Francisco pilot boat**
- **Baltimore dinner excursion boat**
- **Diesel coastal submarine**
- **Special operations boat**
- **Large USCG Cutter**
- **Lobster yacht**
- **New YP**

ENA Students:



Naval Architecture Design Competition (EN246)

Creative Exercises



ENA Students:

Naval architects at the
Baltimore Coast Guard yard



Small classes

Naval Architecture in the Fleet

- **What you will not do:**
 - **Sit at a computer or drawing table and design ships**

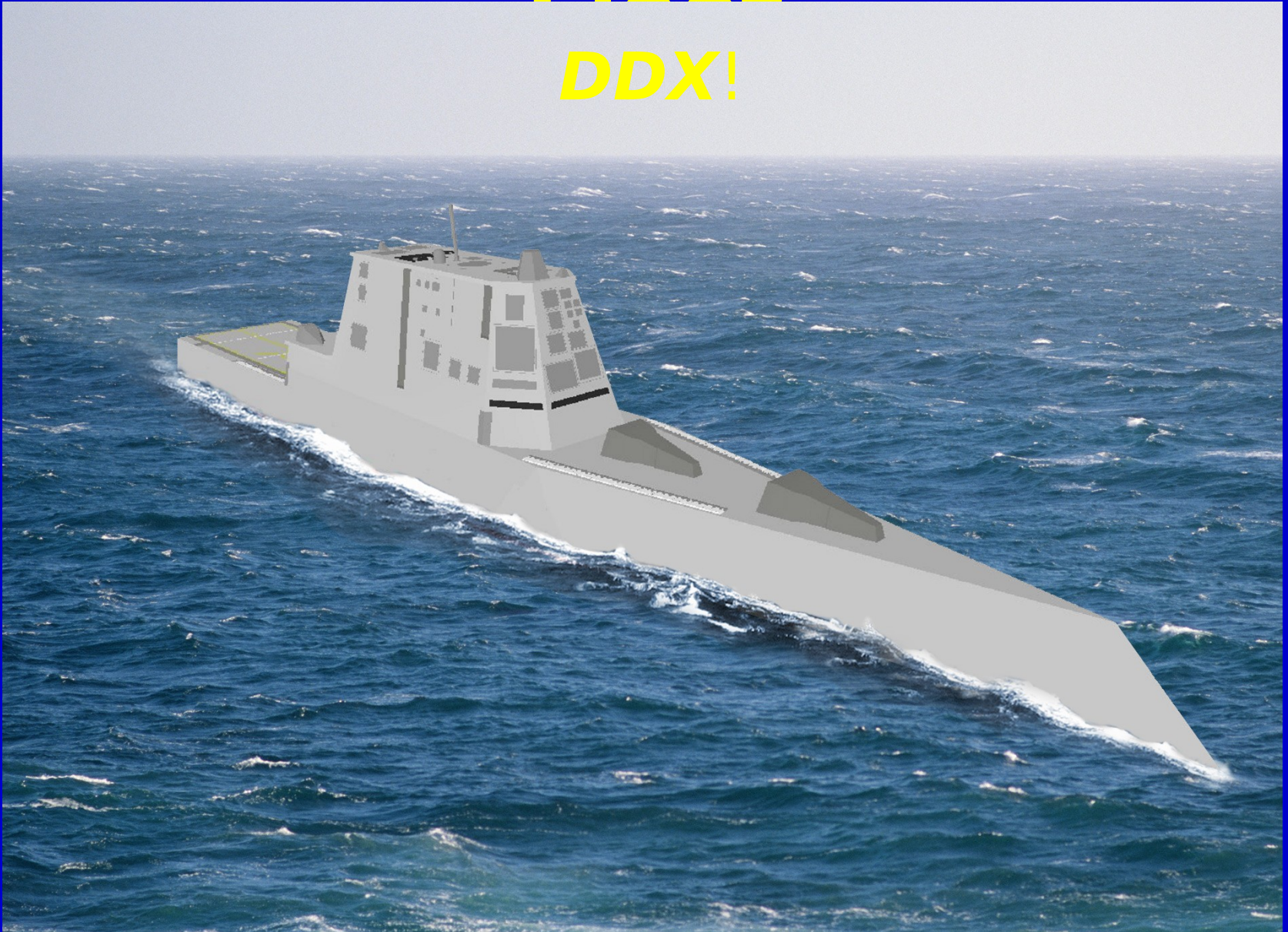


Naval Architecture in the Fleet

What you will do:

- **Use the Engineering thought process to solve problems**
- **Use the Ship and Engineering background you have gained to expedite your watchstander qualifications**
- **In the Fleet, use your knowledge of ship construction and design considerations to better drive and fight your ship during both normal and emergency operations**
- **In Acquisition and Repair, use your knowledge of Naval Architecture to evaluate contractor proposals and ask the right questions to get the best value for the Fleet**

Naval Architecture in the Fleet *DDX!*



Naval Architecture in the Fleet



**High Speed Vessel
(SES)**



Modular Corvette



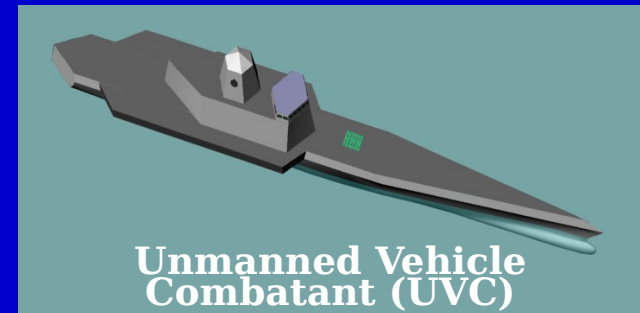
"Blue Knight"



**Small, Fast,
Modular Surface
Combatant**



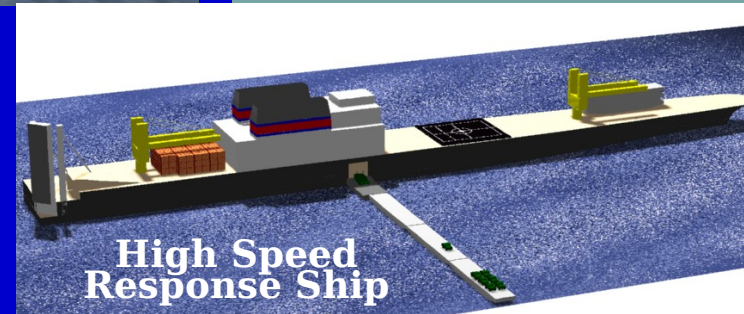
T-JPH (JSF Support Ship)



**Unmanned Vehicle
Combatant (UVC)**



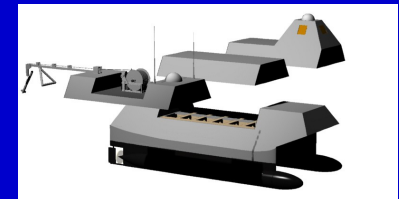
Industry Focused Mission Ship Concepts



**High Speed
Response Ship**



**Unmanned Surface Vessel -
Small (USV-S)**



**Unmanned Surface Vessel -
Medium (USV-M)**

Naval Architecture in the Fleet



Emergency
Responder!

Naval Architecture in the Fleet

What if I want to be a Pilot or Marine?

- **Both:** In either case, you will be a “passenger” on a ship and may need to contribute to damage control. A knowledge of Naval Architecture will make you more useful.
- **Pilot:** Aircraft and ships share the same basic forces and control mechanisms.
- **Marine:** The engineering principles which make a ship float upright have analogies which keep tanks and other vehicles upright. Vehicle control in the surf zone is one of the most challenging areas for the Marines.

Naval Architecture in the Fleet

Why should I become a Naval Architect?

The Navy is Ships and Naval Architects should



Think About Becoming a Naval Architect!

